

### Claims

- 1 1. A method of forming a silicide on a semiconductor substrate comprising the steps  
2 of:  
3 providing a semiconductor substrate having an oxide on a surface thereof;  
4 creating a vacuum over said surface having said oxide;  
5 while in a said vacuum, removing said oxide from said surface of said substrate;  
6 without breaking said vacuum, depositing a metal on said substrate surface; and  
7 forming said silicide on said substrate surface.
- 1 2. The method of claim 1 wherein said substrate is a silicon substrate.
- 1 3. The method of claim 2 wherein said metal is cobalt.
- 1 4. The method of claim 3 wherein said silicide is cobalt silicide.
- 1 5. The method of claim 4 wherein said oxide is removed from said substrate surface  
2 by a nitrogen trifluoride cleaning process.
- 1 6. The method of claim 6 wherein said metal is deposited on said substrate surface  
2 by a vapor sputtering process.
- 1 7. The method of claim 1 wherein said silicide is formed by annealing said substrate  
2 after said metal is deposited on said substrate surface.
- 1 8. The method of claim 1 wherein prior to said oxide removal step, said substrate is  
2 placed into a vacuum device, said vacuum device adapted to provide a continuous  
3 vacuum during said oxide removal and metal deposition steps.

1 9. The method of claim 8 wherein said vacuum device comprises a plurality of  
2 interior chambers, at least one chamber to remove said oxide and at least one chamber to  
3 deposit said metal; the method further comprising the step of transferring said substrate  
4 between said oxide removal chamber and said metal deposition chamber without  
5 breaking said vacuum.

1 10. An apparatus for forming a silicide on a surface of a semiconductor substrate, said  
2 apparatus being adapted to form a vacuum therein, said apparatus further adapted to  
3 remove an oxide from said surface of said substrate and deposit a metal on said surface of  
4 said substrate while maintaining said vacuum, said apparatus comprising:  
5 a chamber;  
6 at least one workpiece holder within said chamber adapted to hold said substrate;  
7 at least one pump adapted to evacuate said chamber;  
8 at least one line operatively connected between said at least one pump and said  
9 chamber for evacuating said chamber;  
10 at least one input line adapted to provide a chemical agent into said chamber, said  
11 chemical agent adapted to remove said oxide from said surface of said substrate;  
12 at least one output line adapted to remove said cleaning agent and said removed oxide  
13 from said chamber;  
14 a heating element in said chamber, said heating element adapted to heat said substrate  
15 to an elevated temperature; and  
16 a reactor in said chamber, said reactor adapted to deposit said metal onto said  
17 substrate surface.

1 11. The apparatus of claim 10 wherein said apparatus is further adapted to heat said  
2 substrate to form said silicide on said surface of said substrate.

1 12. The apparatus of claim 10 wherein said chamber comprises a plurality of interior  
2 chambers, at least one interior chamber adapted to remove said oxide from said surface of

3 said substrate while under said vacuum, and at least one interior chamber adapted to  
4 deposit said metal on said surface of said substrate while under said vacuum.

1 13. The apparatus of claim 12 further comprising at least one interior chamber  
2 adapted to heat said substrate.

1 14. The apparatus of claim 12 wherein said apparatus is adapted to transfer said  
2 substrate between said interior chamber adapted to remove said oxide from said surface  
3 of said substrate and said interior chamber adapted to deposit said metal on said surface  
4 of said substrate without breaking said vacuum.

1 15. The apparatus of claim 14 wherein said substrate is a silicon substrate.

1 16. The apparatus of claim 15 wherein said apparatus is adapted to remove said oxide  
2 from said surface of said substrate using a nitrogen trifluoride cleaning process.

1 17. The apparatus of claim 16 wherein said metal is cobalt.

1 18. The apparatus of claim 17 wherein said interior chamber adapted to deposit said  
2 metal on said surface of said substrate is a vapor sputtering device.

1 19. The apparatus of claim 18 wherein said apparatus is further adapted to transfer  
2 said substrate to said heating chamber from said metal deposition chamber.

1 20. The apparatus of claim 19 wherein said silicide is cobalt silicide.